WHOSE INFORMATION IS IT ANYWAY? AN ARGUMENT FOR INFORMATION STEWARDSHIP

THESIS

Trevor W.M. Plant, Flight Lieutenant

AFIT/GIR/LAR/96D-6

DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY
AIR FORCE INSTITUTE OF TECHNOLOGY

Wright-Patterson Air Force Base, Ohio

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Trevor W.M. Plant, BE (Aero), Grad Dip Comp Eng

Flight Lieutenant

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Abstract

Information is an important resource for businesses and government, with information quality influencing decision quality, and highlighting our need to manage our information well: as a resource. Information Resource Management (IRM) has as its goal the management of information as a resource, but has not been implemented with the level of success expected. Problems with the implementation of IRM are indicated by the presence of redundant or inconsistent data, inability to share information across systems, and difficulty finding the information on systems. We propose that these difficulties are related to behaviours linked to perceived ownership of corporate information by organisational sub-units. To evaluate the proposition, we performed a case study on an organisation to see if we could identify the presence of problems, and the presence of the ownership behaviours. The case study revealed the presence of both problems with information management and behaviours related to ownership. To improve the management of information in organisations, we recommend that organisations take ownership of the information resource at the corporate executive level, and educate users of the information on the benefits of stewardship of the information they use. This will encourage staff at all levels to see information as a resource, not merely a cost of doing business.

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I. Introduction

Today, the concept of information as a resource is all but pervasive in the world of information systems, and most organisations now recognise the need for management processes for information along lines similar to those of the other recognised resources: land, labour and capital (Diebold, 1979:51; Drucker, 1992:95; Brancheau et al, 1987:23; Tom, 1991:3; Lewis et al, 1995:200; Lytle, 1986:310; Cook, 1982:53; King et al, 1982:189). Some authors, most notably Drucker, have even gone so far as to postulate that information (as knowledge) is in fact the primary resource of the knowledge society, superseding the traditional trio (1992:95). Although information was originally seen as a costly overhead to doing business, the technology evolved that allowed better use of information, and we began to see it as a resource. An indication of the increasing value of information is the rising proportion of the GDP of nations like the United States that is derived from information or knowledge work (Tom, 1991:2). This trend adds weight to the perception that information is now more a resource than a cost of doing business.

Even with this increasingly pervasive view of information as a resource, few organisations manage information in the same fashion they would finances or capital equipment. Typically information technology has been applied to solve a problem once, and then neglected until it is time to unleash new versions of technology on the problem.

This has been the case from the introduction of file processing systems, through early database systems and now with integrated management information systems.

A solution to the problem of information systems and technology management is offered by the proponents of Information Resource Management (IRM) (Bryce, 1987:89). IRM is a field that has its origins in the late 1970's and early 1980's, and during that period was discussed widely and positively, as evinced by Levitan's (1982) and Lytle's (1986) reviews of the literature. However, the field has been plagued by a lack of usable consistent definitions and principles that can be applied by the organisational information manager (Lewis et al, 1995:203; Lytle, 1986:327). Of late the discussion has been revived, partly because of the emergence of the Internet as a means of sharing organisational information in a relatively inexpensive fashion.

Background

The recognition of information as an organisational resource has at once been helped and hindered by the same technologies. The evolution of technology in the computing industry makes the treatment of information as a resource possible, yet at the same time the rate of evolution makes the achievement of stability and possibility for management of information exceedingly difficult. The introduction of personal computer based networks into most organisations has made the user aware of the potential for use of information in an organisational setting, but has continuously frustrated that promise.

The proliferation of information systems has significantly increased the volume of information that needs to be managed, and the disparate systems on which this information

exists have prevented integrated management of the information. Consequently we feel ourselves to be often overloaded by the amount of information that we receive and must process to be able to make quality decisions.

The current economic environment for most organisations makes it even more imperative that we apply some management flair to the information resource. After all, the benefit of information is that it can aid the use and management of other resources by improving the decision quality where they are concerned (Lytle, 1986:311; Meltzer, 1981:60). However, this improved decision quality can only be achieved if we improve our management of information. To this end we will look at the role of information resource management (IRM) in providing the necessary change in organisations to improve information management, and improve the utilisation information systems.

Early applications of computers were intended mostly to *pave the cowpaths* and automate manual systems in organisations, providing a means of speeding up data processing tasks for specific applications. These early applications were based on file processing, and were not very portable or capable of easily sharing information with other applications, even those running on the same computer system. The process of making the different, independent applications communicate with each other and share data files often required changing the structure of the data files, and in most cases the application programs as well, to match the new data file structure (McFadden et al, 1993:17; King et al., 1982:187). This process was so difficult to manage and so prone to error that "as information needs were recognised, they were satisfied through dedicated applications and

dedicated data files (King et al., 1982:186)" leading to gross duplication of data and propagation of inconsistency and errors.

On the positive side, the development of these file processing systems did reduce the overall cost of data capture and information production, by reducing the number of staff involved in capturing and collating the data. On the negative side, these computer systems were extremely expensive to purchase and maintain.

The next significant phase in the information revolution was the introduction of database management systems (DBMS). The DBMS was intended to overcome the various problems of using a stand-alone systems development approach for each new system. The required data would be identified up front as part of the database development, and would be available to any application created in the same DBMS – essentially creating a data pool from which data could be drawn to create new information (King et al. 1982:187). Three models of the database management system emerged for consideration by users: the hierarchical, network and relational models. Of these, the most important development was that of the relational database model by E.F. Codd in 1970. The relational model provides the best support for IRM because it provides the greatest flexibility and ease in the sharing of data among applications.

The increased flexibility and commensurate increase in use of the Relational Database Management System (RDBMS) allowed databases to proliferate in many organisations, often without much planning or control. This issue was addressed through the development of the field of information resource management (IRM) in the 1970's and 1980's, partly as a result of the Paperwork Reduction Act (PRA) of 1980. Since that

time, much has been written on the development of the IRM field, with Lytle (1986) providing a sound review of the progress during the 1980's. Lewis et al (1995) attempted to further refine the IRM concept and provided eight dimensions by which the level of IRM implementation in an organisation can be measured.

Problem Statement

Despite the advances in information technology, sharing corporate information effectively remains an elusive goal. The advent of relational database management systems has alleviated some of the original problems but most information systems still are very poor at sharing information with each other. This is of some concern with management appearing to support the view of information as a resource with the development of senior executive positions in many organisations with titles like Chief Information Officer (CIO), Chief Data Officer (CDO), data administrator etc. These titles all speak to an increasing importance of information to organisations, and to the implementation of the principles of IRM, but still information is poorly managed. The question that needs to be asked is why is information so poorly managed? Why do information systems still have high levels of redundancy and inconsistency? Why is the resource information allowed to be squandered through inappropriate management?

The research will investigate the proposition that a primary cause for failure of information management techniques, such as IRM, is the unexpected impact of the concept of ownership of information. This research will propose the concept of

stewardship as an alternative to ownership of information at the organisational sub-unit level.

This position will be tested using a case study methodology. The case study was deemed an appropriate technique because it provided the opportunity to take the theoretical knowledge into the field and compare theory with practice, allowing the researcher to make observations about the differences. Further, the case study allows the researcher to observe the actions, present and historical, of the subjects to determine their level of understanding of the principles of information resource management. Finally, the case study uses multiple sources allowing for verification of data across interviews and sources.

The subject selected for the case study was the Air Force Institute of Technology (AFIT), Wright-Patterson Air Force Base (WPAFB), Dayton, Ohio. AFIT is a component unit of Air University (AU) and the major command Air Education and Training Command (AETC) in the United States Air Force (USAF). AFIT is the USAF's graduate school and the site for many professional continuing education (PCE) courses. Like most government departments it has a substantial information systems infrastructure. In Winter 1996 the Commandant commissioned a study on the possibility of creating an Executive Information System (EIS) for AFIT executive staff. The author was a member of the team that completed the investigation of information needs and capabilities (Heminger et al, 1996).

The data collected during that study will be analysed from the perspective of information management and ownership for this research.

Research Question

There were three primary investigative questions that served to focus this research effort, and these are described below.

1. In an organisation that demonstrates inadequacies in management of information, can we identify behaviours related to perceived ownership at sub-unit level?

The behaviours observed reflect the perceptions of those who work with information and affect how they treat that information. As an owner of any item there is a more proprietary attitude in its use and a general reticence to share it. This question is intended to focus on the impact of ownership perceptions of the individual on the organisation as a whole. Our contention is that the ownership rights belong to the organisation, with stewardship granted to the individual as the need arises. The issue of ownership relates directly to the level of successful implementation of the principles of IRM in organisations in general, and the threats posed by redundancy and inconsistency of information, to name a few of the potential limiting factors.

2. Does it appear that these ownership behaviours at sub-unit level are responsible for the inadequacies of information management?

Knowing that owning is different from stewarding, do we detect any effects from the actions of owners and stewards? We believe that owners will be more likely to maintain separate data sources that are not linked to the primary organisational sources, and so run the risk of contamination and inconsistency and redundancy. Further, the owner will not volunteer the presence of this source until directly confronted, but will seek

out other similar sources. In this instance the issue of political utilisation of information is of interest.

3. What recommendations can be made that would be likely to improve the management of organisational information?

If we do find differences in the actions of people depending on their perception of ownership or stewardship of information, then there is practical value in considering what steps we might take to improve the management of information inside the organisation. These improvements could be applied inside an organisation to improve the overall management and control of the information resource.

Summary

This study will explore issues of perceived information ownership and their impact on the effective management of organisational information. The study is organised into five chapters. This chapter, Chapter I, provides the introduction and background for the research, and details the problem statement and investigative questions that are the basis for the research. Chapter II will provide a review of the current literature, beginning with a brief history of information in post industrial revolution organisations and addressing the change in treatment of information and its acceptance as an organisational resource. The chapter will then address the most prevalent methodology for managing information inside organisations: Information Resource Management, and introduce the concepts of information ownership and stewardship. Chapter III will address the methodology for conducting the research including detailing characteristics of the subject of the research,

and the data collection technique. This chapter will also detail the propositions used to examine the organisation. Chapter IV will provide the results of the data collection and the analysis of these results in light of the propositions detailed in Chapter III. Finally, Chapter V will discuss the results obtained in Chapter IV along with implications and suggestions for future research.

II. Literature Review

Overview

This chapter will explore the literature to present a current view of how information is treated in organisations. It will provide evidence that information is in fact being treated or identified more and more as a resource for corporate organisations to manage, and provide a set of principles that describe the approach necessary to manage information, information resource management (IRM). The chapter will describe how this management approach is failing. Finally, the chapter will posit that the cause for the lack of success of IRM implementation to this point is related to the lack of understanding and acceptance of the power of information ownership in the organisation.

Historical perspective

To help in understanding why Information Resource Management is necessary, it is beneficial to review where information and data management have been, and how these areas have developed, particularly the impact of improvements in computer and communications technology.

Early Data Processing. Information, the amalgam formed from the raw material data, has always been of great value to Homo Sapiens. The knowledge that has been gained through the analysis of this information, has enabled us to advance rapidly, performing ever more complex feats: the steam engine, the aeroplane, the computer, the

space shuttle. None of these events would have been possible without the collection and aggregation of information to form the various disciplines of science, engineering and management.

The medium and method of presentation have changed but the value of information remains. To a greater extent it is the changes in the medium that have

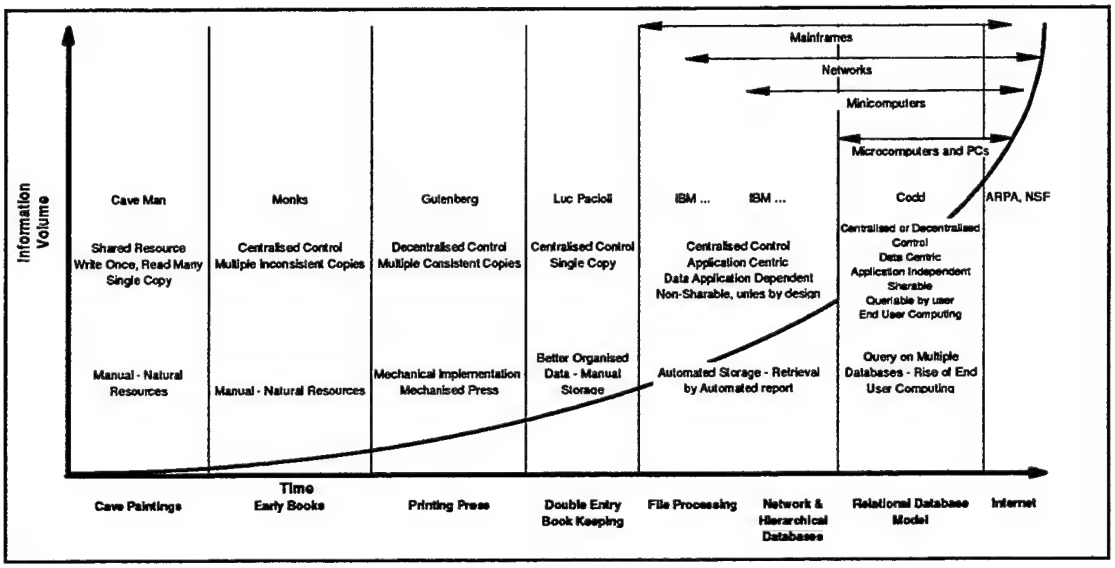

Figure 1: Information Production and Use Through the Ages

facilitated the advances in the disciplines above. Figure 1 illustrates, in broad terms, some significant points through the history of data processing and their impact on information volume and availability. Notably, the most significant increases in volume are occurring right now, with the popularity of the Internet and World Wide Web moving large amounts of data into the realm of accessibility for any and all who wish to use them.

The industrial revolution gave rise to manufacturing organisations on a scale not hitherto seen. These large organisations needed to develop systems for controlling and managing the company. The earliest forms of mass data processing systems were employed by these companies and were manual and paper based, requiring legions of clerical workers to manage and maintain the paperwork that kept organisations running.

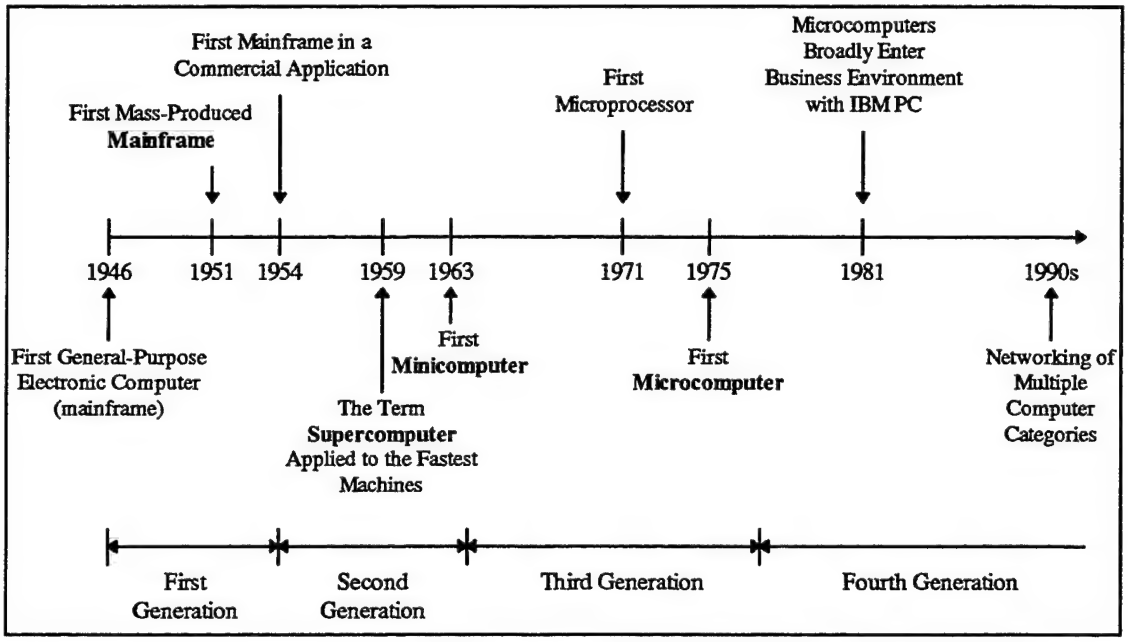

Figure 2: Significant Events in Computer Development
(Zwass, 1992:198)

Needless to say the cost of employing and managing a large group of employees for the sole purpose of maintaining paper records made information collection an expensive necessity. Further, the manual nature of the process introduced errors of many forms: transcription errors; duplication and redundancy errors; inconsistency errors; pure arithmetic errors. All the more reason for concern was the fact that the primary focus of these systems was financial control and management.

This trend continued into the first commercial electronic data processing systems which were initially focused on financial data processing. The earliest computing system used in a business application was a UNIVAC I, built in 1951 and adopted by General Electric in 1954 (Zwass, 1992:200) (see Figure 2).

File Processing Era. The early computing systems utilised applications based on batch operation and file processing. The applications were programmed using punch-cards, a painful and laborious process, also prone to errors. The data for the application to manipulate was prepared on the cards and then loaded into the computer in a batch process, usually overnight. The data was stored in a file on the system secondary storage media – at this time usually paper or magnetic tape.

The available memory of these early machines was (by today's standards) extremely small, typically 2-4 kilobytes (Kb) (see Table 1). This scant memory resource had to be managed extremely well during program operation to prevent the system from *crashing*, consuming valuable time and manpower to reload and re-run jobs. Consequently, the file processing system was usually tailored to the particular computer and peripherals on which the application was being run, to optimise the usage of memory, and increase overall computation speed.

Applications based on file processing, therefore, were not very portable or capable of easily sharing information with other applications, even running on the same system. Although possible, the process of making the different independent applications communicate with each other and share data files would often require changing the structure of the data files and in most cases, the application programs as well, to match the

new data file structure (McFadden et al, 1993:17; King et al., 1982:187). This process was so difficult to manage and so prone to error that "as information needs were recognised, they were satisfied through dedicated applications and dedicated data files (King et al., 1982:186)," leading to gross duplication of data and propagation of inconsistency and errors.

On the positive side, the development of these file processing systems did reduce

Table 1: Computer Generations
(Zwass, 1992:200)

GENERATION	FIRST	SECOND	THIRD	FOURTH
Years	1946-55	1956-63	1964-77	1978-present
Fundamental technology	Vacuum tubes	Transistors	Integrated circuits (small-to large-scale integration)	VLSI and microcomputers
Prominent computers	UNIVAC I and II IBM 700 series	CDC 3600 IBM 7000 series RCA 501	CDC 6600 and 7600 IBM System/360 and 370 DEC PDP-8 and PDP-11	Cray Y-MP IBM System/390 and EX/9000 DEC VAX 6000 IBM PC, PS/2 Apple Macintosh
Typical speed (instruction per second)	40,000	200,000	1-10 million	10-300 million
Typical size of main memory	2-4 Kbytes	32 Kbytes	256 Kbytes-2Mbytes	16-512 Mbytes

the overall cost of data capture and information production, by reducing the number of staff involved in capturing and collating the data. On the negative side, these computer systems were extremely expensive to purchase and maintain and, as stated, they did not share information easily.

Databases and Data Independence. The next significant phase in the information revolution was the introduction of database management systems (DBMS). The DBMS was intended to overcome the various problems of using a stand-alone systems

development approach for each new system. The required data would be identified up front as part of the database environment, and would be available to any application created using the same DBMS – essentially creating a data pool from which data could be drawn to create new information (King et al. 1982:187). Three models of the database management system emerged for consideration by users: the hierarchical, network and relational models. Of these, the most important development was that of the relational database model by E.F. Codd in 1970.

Hierarchical and Network (CODASYL) Models. The precursors to Codd's relational model were the hierarchical and network models. The hierarchical model was developed by IBM and continues to be used on mainframes today (McFadden et al., 1993:493). The hierarchical model creates a structure that looks like an organisational chart. More precisely, each record has a parent record at the root level of the tree structure to which it is linked. Given that many real world situations are not hierarchical, these databases require duplication of records or links that would break the hierarchy (Zwass, 1992:299-301, McFadden et al., 1993:494-496). In practice, the duplication of records is usually employed (Zwass, 1992:300), and this contributes to continued redundancy issues. The network database model is more general than the hierarchical model, consisting of records that may be linked using a *network* of pointers (Zwass, 1992:301). This inter-linking of records removes the need for the duplication of records. The network model is also called the CODASYL (COnference on DAta SYstems Languages) model for the standards organisation responsible for maintaining the standardised definition for the networked database (Zwass, 1992:301; McFadden et al., 1993: 517).

In general these models performed better than the single purpose file processing systems, providing that care was taken with the initial design of the system. However, they were still limited by the need for extensive knowledge about data models employed, and the difficulty of modifying these models as needed. The relational model addresses many of these concerns.

Relational Model. The relational model overcomes these problems by providing easy access to stored data, thus simplifying the process of sharing information between systems. The relational model is deliberately created independently of the application, and thereby simplifies integration of data across applications, by creating a known pool of data available for use by applications. This data independence also reduces the maintenance impact of changing components either in hardware or in software applications. One change in an application does not preface a major rewrite of other applications to maintain application validity.

Information as a Resource

As the technology evolved that allowed better use of information, we began to be able to share information among different applications. Information that had been collected for one purpose could be combined with other information, thereby serving additional purposes as well. This allowed us to see information as a resource. Today, the concept of information as a resource is all but pervasive in the world of information systems, and most organisations now recognise the need for management processes for information along lines similar to those of the other recognised resources: land, labour

and capital (Diebold, 1979:51; Drucker, 1992:95; Brancheau et al, 1987:23; Tom, 1991:3; Lewis et al, 1995:200; Lytle, 1986:310; Cook, 1982:53; King et al, 1982:189). Some authors, most notably Drucker, have even gone so far as to postulate that information (as knowledge) is in fact the primary resource of the knowledge society, superseding the traditional trio (Drucker, 1992:95).

Given this, we would expect to find that information is carefully managed and fully utilised in organisations. However, this is not what we find. Authors such as Diebold indicate that information has been consistently "...underutilized and its contribution underrated (1979:51)." This is somewhat disconcerting given that the "central tenet of the Information Age has been the crucial significance of information and the crucial importance of its management to the enterprise" (Lewis et al., 1995:200). Walter M. Carlson highlighted the true value of information to the enterprise by noting that "information conserves other resources through better decisions" during his keynote speech to the Annual Meeting of the American Society for Information Science in 1977 (Meltzer, 1981:60). This notion was echoed by Diebold when he suggested that "using information to conserve resources ... certainly must be [a] major corporate objective" (1979:53).

As further noted by Diebold (1979) the "organizations which excel ... will be those that recognize information as a major resource and structure it as efficiently as they do other assets." So, in order that the organisation may have the opportunity to excel, and given the value of information, a management approach for information needs to be developed. The general term for this view of information as a resource has come to be

known as Information Resource Management (IRM) (Lewis et al., 1995:200). The concept of IRM has been around for some time. Adrian McDonough introduced the concept in testimony before a congressional hearing, suggesting that *information economics* were important – recognising that information is produced and is a factor of production and, importantly, can be used to address the management and costs of other components (Horton, 1979:11-14). The United States Federal government took an interest and defined IRM in the Paperwork Reduction Act (PRA) of 1980 as:

> the term "information resources management" means the planning, budgeting, organizing, directing, training, promoting, controlling, and management activities associated with the burden, collection, creation, use, and dissemination of information by agencies, and includes the management of information and related resources such as automatic data processing equipment. (44 USC 3502)

The PRA was developed during the 1970's and finally written into law in the United States as Public Law 96-511, Title 44 US Code, Section 35. The PRA was intended to reduce the level of unnecessary paperwork within the US government and its many agencies (Bishop et al, 1989:41).

Much has been written on the development of the IRM field, with Levitan (1982) and Lytle (1986) providing sound reviews of the progress during the 1980's. Lewis et al (1995) attempted to further refine the IRM concept and provided eight dimensions by which the level of IRM implementation in an organisation can be measured. The eight dimensions are listed in Table 2:

IRM: Managing the Information and not the Hardware

One of the interesting aspects of the field of IRM is the lack of agreed definitions and constructs that allow discussion within the field. This lack becomes more obvious when we discuss what the term information resource management means. As reported by Lewis et al., Guimaraes identified three separate views of IRM: Management of the

Table 2: Eight Dimensions of IRM
(Lewis et al, 1995:218-219)

Chief Information Officer	Responsible for corporate wide IT policy, planning, management and acquisitions
Planning	Inclusive IT/IS strategic planning process
Security	Disaster recovery and access control scheme
Technology Integration	Integrated approach to IT and communications
Advisory Committees	User/management groups dealing with systems and technology issues
Enterprise Model	Model of the business capturing processes and data structure, involving the use of integrated, automated design tools
Information Integration	Integrated data and application systems with data sharing
Data Administration	Function headed by a database administrator with a corporate architecture and policies on data ownership

information resource; management of IS development; and management of computer resources (1995:200). The second and third views are concerned with information systems and information technology as resources, not information itself.

While recognising that Information Systems (IS) and Information Technology (IT) are key elements of the resource picture for information, we cannot lose sight of the fact that information is a resource to be managed, and that the computer can serve to make

that task more efficient and effective, if employed correctly. However, we must recognise that IT and IS are not fundamental resources at the level of information.

With these comments in mind, we should note that the eight dimensions in Table 2 provide a reasonable point from which to move in terms of solidifying the principles of IRM, as far as information is concerned. By focusing on the information and not the means of transmission, we can refine the eight dimensions and determine a more appropriate set for managing information as a resource.

For this reason, it is necessary to review the basis on which Lewis et al proposed their model. Of note is the fact that the authors surveyed MIS professionals and academics, the very architects of our current information systems. The responses provided refer to management of the information systems resource, not the information resource. These represent two views of IRM, as reported by Lewis et al.

We see that if we consider the principle to be information managed as a resource, then we require an enterprise wide view of data to allow us to determine what information we may draw from our store. Finally, the integration of applications, to share data that is consistent, non-redundant, and accurate requires the technological availability of the relational database. The failure to fully implement these principles results in a view more reminiscent of the early days of independent system development by organisations, with the creation of system after system with little or no integration, and separate data files for each. This situation is illustrated in the MIS Model for IRM in Table 3.

In this real world model (Table 3), we find that the components of the information resource that gain most attention are the information system or information technology. The difference in principles of the real world model and Lewis et al.'s eight dimensions, is the lack of treatment of strategic planning and enterprise modelling. The strategic planning components take the business plan and goals for the organisation and develop an Information Strategic Plan for the organisation. This plan determines where financial resources and human resources will be positioned to develop and maintain components of

Table 3: MIS Model of Information Resource Management

Level of Abstraction	Construct	Principle	Implementation
Corporate	Information	Information systems to support individual information needs	Multiple Standalone applications
Physical	Data	Multiple independent system data models	Applications drawing from inconsistent, inaccurate data files; redundant data in multiple files

the organisational enterprise information system.

The Principles of Information Resource Management

If we review the models above with an eye to creating a set of management principles more consistent with managing information as a resource, then we can recognise the principles in Table 4.

We can see that the principles in Table 4 are focused away from the technology and more towards our view of information in the ideal model of Table 5. The focus has moved, as Trauth describes, from the raw material (data) to the output product (information) of most systems (1984, 13). The enterprise view coincides well with

Table 4: Information Management Principles Focusing on Information

Enterprise information structure CIO Data Administrator Database Administrator	• higher level support for the model • injection of information management knowledge in the boardroom • single "bellybutton" for data management issues • policies for access and use of data • physical implementation of organisational data policies in the enterprise model of data
Strategic Planning	• Determine the business • Define the business requirements for information • Create information strategic plan • CIO is champion at this level
Enterprise Wide Data Model	• models the data (and potentially the processes) that the organisation cares about
Security	• control access to information • prepare disaster recovery plans

Martin's widely recognised information engineering approach, focusing on a top down, strategy driven view of information management (1989:3-4).

Who Should Own Information - an Organisational Behaviour View

Information Management and Control. If we accept that information is a resource, and can and should be managed as such, then we must accept that ownership of that information is an issue that must be addressed. Ownership of a resource, in literal terms, implies that a person or organisation has the legal right to control the distribution and use of that resource. Using the analogy of finance, ownership of funds gives a company the right to use those funds as it wishes, within the bounds of the law. Thus a company may

Table 5: Ideal Model of Information Resource Management

Level of Abstraction	Construct	Principle	Implementation
Corporate	Information	Information as a resource	Integrated applications
Physical	Data	Enterprise data model	Applications developed per business need, drawing from a common pool of consistent data

invest the funds, pay employee bonuses or simply allow the owners to spend the profits.

Ownership also implies that the owner may trade the resource as necessary for other resources. Market research organisations are an example of companies exchanging other resources for the information they gather about particular markets or groups within markets. This ownership also provides the organisation the right to move the resource to the place in the organisation in which it will do most good.

While the above are likely scenarios within the organisation when considering money, this is not what we typically see when we look at information. Information isn't available to be distributed, managed or controlled as management would like it to be. Instead we see pockets of information that are separate from the wider organisational pool

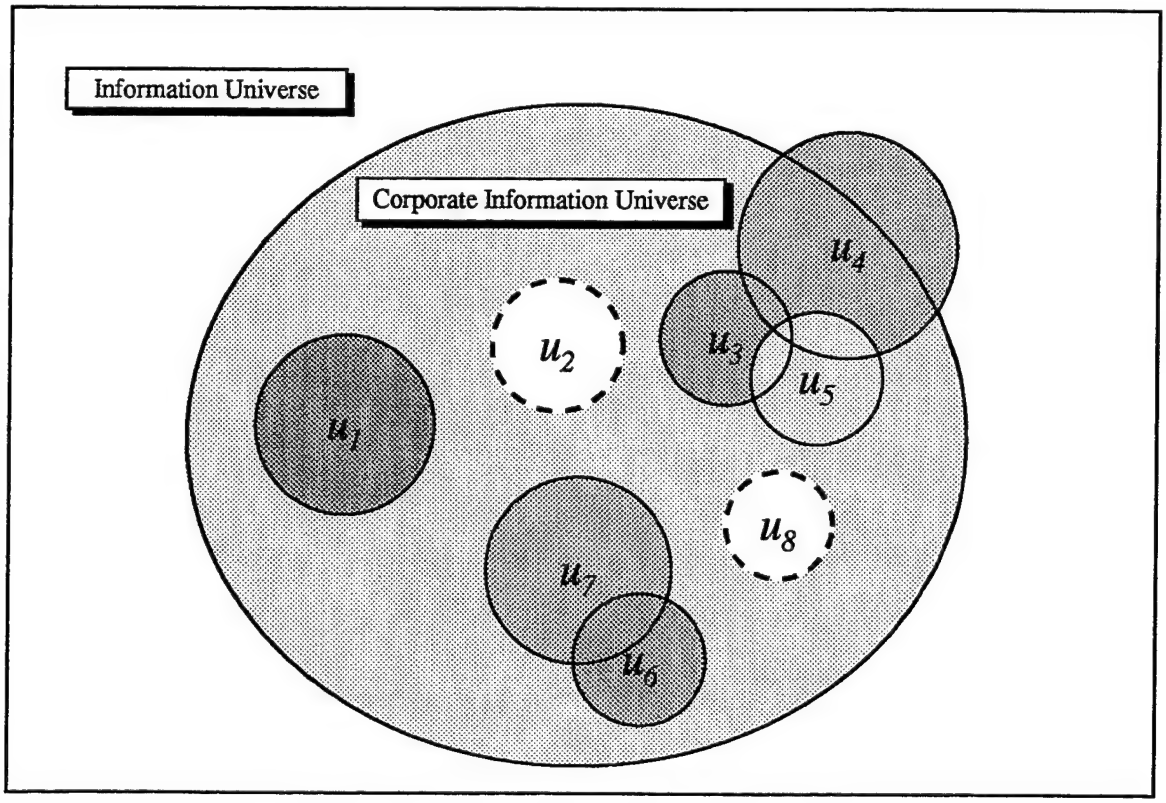

Figure 3: Swiss Cheese View of Information

being maintained by staff, but that are not visible to all. Consider Figure 3. In this Venn diagram we see the various pools of information inside the corporate organisation as sets, some of which intersect with other sets inside the organisation, and some of which are independent. Further still, some of the sets intersect with information in external sets – for instance the social security system in the United States for Social Security numbers.

The position responsible for managing information inside the organisation needs to have a view of all the information available in the corporate information universe, to allow that information to be appropriately shared and utilised by the members of the organisation. If we consider sets u_2 and u_8 to be hidden sources, as indicated by the dotted outline, then these sets represent a store of information the existence of which the organisational information manager is unaware, and so cannot manage it. It follows that the organisation cannot control or use that which it cannot see. If there are multiple sources of this type then we can see that the organisation has a Swiss cheese view of their information base, and is not in control of all of its information resource. Although staff may talk about the organisation's information, their actions belie this, with maintenance of independent and uncontrolled information sources proliferating throughout most organisations.

Ownership also provides the owner with the right to modify or change the information in the act of producing it, leading to the need for ownership of processes and information for organisational improvement through methodologies such as business process re-engineering (BPR) or information engineering. These approaches require that the "owner" of the information or process take responsibility for the changes to it and modifications to the overall process. After all, only the owner had the authority to make decisions about the life or use of information.

Ownership is important from the viewpoint of management, and the connection is control. As organisational behaviour theorists such as Fayol posited with their administrative management theories, management requires performance of the functions of

planning, organising, commanding, co-ordinating and controlling (Gray et al., 1989:52-53). Even if we do all of the preliminary tasks well, if we cannot control then we cannot manage. If we consider the relationship of control and ownership, which appear to be intimately linked, then we begin to see that poorly defined and executed ownership policies will affect the organisation's ability to control and hence manage their information resource.

Therefore, there is the potential for organisational subgroups to affect the value and quality of the information resource by presuming ownership, and concealing the information from the enterprise model and operating outside the management policies.

Information Stewardship. An alternative to ownership of a resource is stewardship or guardianship. The dictionary defines a steward as someone who manages property or finances on behalf of another, the owner (Webster's 3rd New International Dictionary). This is a concept with which government and industry alike are acquainted. The government is provided with stewardship of the nation's affairs when elected to office, with the control and management of defence, foreign trade, foreign policy, domestic policy, budget appropriation, and so on. Members of the elected government are given responsibility for the appropriate use of resources entrusted to them, and that responsibility is exercised in their management of the resources: appropriate use is rewarded with continuation of service at the next election. At all times elected representatives must remember that they do not own resources, and the creation of the hidden stores (as illustrated earlier in Figure 3) is a serious breach of the trust placed in them by their constituents.

Public companies, those traded on the stock exchanges of the world, are given their authority and responsibility to act as stewards in a similar fashion to governments. The executive board of directors are elected by the share holders, and duly appointed to control the organisation. Part of the stewardship of an organisation or a country (through government) requires the steward to take responsibility for the effective use of resources available to him, with the knowledge that at some point in time, the owner may require an accounting of how that resource has been used. Just as there is a Chief Financial Officer (CFO) who is ultimately responsible for the use of dollars on behalf of the organisation, information requires there to be a Chief Information Officer responsible for information on behalf of the organisation.

The concept of stewardship then is not new to us. When the specific resource under consideration is information, the approach that is used to manage the resource should be no different than for dollars or facilities: information requires stewardship inside the organisation. Stewardship requires the acceptance by the user that the information belongs to the organisation as a whole, not any one individual. The information should be shared as needed, and monitored for changes in value.

The Conflict: Ownership versus Stewardship

Observation of problems emanating from the use of information systems suggests that many problems result from issues related to the perceived ownership of information. "Ownership of information" at sub-unit organisational levels is a concept that is supported by many IS professionals. However, a careful consideration of the realities suggests that

"information stewardship" is a more relevant concept for managerial control of organisational information (March et al, 1992:27). It is the thesis of this research that development and support for the role of "information stewardship" provides an environment more supportive of wise information usage within an organisation.

BPR and other modern approaches to "re-engineering" the business rely heavily on the use of new information systems and technology to improve the day-to-day operations of the company including the quality of information available for use by managers in making decisions. The perceived threat to formal and informal control systems that these approaches represent indicate that a clear perspective on ownership and alternatively, stewardship is needed.

In the stewardship approach, a person may take on the role of information keeper, maintainer, provider – but always with the knowledge that the stewardship is a temporary thing. Ultimately ownership resides with the organisation (Owen, 1989:21).

As outlined earlier in this chapter, the view available of information may well depend on the user's perception of ownership or stewardship for the information as a whole within the organisation. With individuals owning the information, there is a higher potential for the creation of uncontrolled data pools, contributing further to the number of holes in our pieces of Swiss cheese.

Summary

Information is being treated more and more like a resource inside organisations. This has occurred through the need to manage the increasing amounts of information that

are being produced by the rising number of information systems. The days of using file processing systems based on tightly coupled data files have given way to the relational database, enterprise data model and data independence from applications. These changes, all significant, have forced managers to review their perceptions of information as a cost of doing business, and realise that information used wisely can enhance the use of the other factors of production: land, labour and capital.

Given that information is a resource, we determined that information must be managed and controlled to be used effectively. The management of information is best performed through the application of the principles of IRM, focusing on a corporate information management structure, strategic planning, enterprise wide data model, data administration and security of information.

We extended our discussion to describe how information management must also consider the ownership or stewardship of information in the organisation, by virtue of the need to control the information to manage it effectively. We prescribed stewardship of information as the preferred level of control for organisational elements.

III. Methodology

Overview

The literature to this point has suggested that information is a resource, and that it should be managed as a resource. To explore the accuracy of the propositions presented in the introduction, a case study method was chosen. This chapter will provide the design for that methodology.

Case Study Design

The case study is a technique that is most appropriate in asking 'how' or 'why' questions, particularly when the investigator has little control of the conditions (Yin, 1989). The case methodology can also be used to ask exploratory 'what' questions (Yin, 1989). Yin further defines case studies as

> an empirical inquiry that investigates a contemporary phenomenon within its real life context; when the boundaries between phenomenon and context are not clearly evident; and multiple sources of evidence are used. (Yin, 1989:23)

The Study's Questions

The study is broaching the issue of ownership of information from the point of view of the organisation. There are three primary questions that we wish to answer from the case study, as outlined in Chapter I. These questions are:

1. **In an organisation that demonstrates inadequacies in management of information, can we identify behaviours related to perceived ownership at sub-unit level?**
2. **Does it appear that these ownership behaviours at sub-unit level are responsible for the inadequacies of information management?**
3. **What recommendations can be made that would be likely to improve the management of organisational information?**

In the context of this research, we are using a case study to examine the level to which the principles of Information Resource Management have been implemented in the organisation under study, and to determine if the ownership of information at a sub-unit level has affected the success of the implementation. To qualify these issues, the propositions described later in this chapter will be tested.

Propositions

The literature review of Chapter II indicated that the trend is towards the recognition that information is, in fact, a valuable corporate resource, and should be managed as such. The means to implement that management philosophy has been identified as Information Resource Management (IRM). Chapter II also developed a set of principles that define IRM as it should be applied in organisations. The relevant factors of IRM were strategic planning, enterprise wide data model, security, and an enterprise information management structure.

The description of these areas provides us with the opportunity to state several propositions to be evaluated during the case study analysis. The propositions will be focused on two aspects: structural and operational. The propositions will be used to indicate the level to which an organisation has adopted IRM, the structural components,

and will aid in determining if ownership of information is an issue in the organisation, the operational components.

Structural Propositions. For information to be shared and used widely in an organisation, its raw material, data, must be well understood and managed. Information is, after all, data that has been synthesised. For data to be shared to allow the best quality information to be developed, then there must be a common understanding of the basic elements of the data. This amounts to the presence and maintenance of an enterprise data model. This will be facilitated by the use of relational databases to improve the ability of the data administrator to manage access and requests for access to the individual data elements.

The following provide the set of structural propositions of interest to this study. These propositions focus on the implementation of the information resource management principles identified in Table 4 of Chapter II, and particularly on the manifestations in the organisational structure. These propositions can be evaluated based on the presence or absence of the element described.

> **Proposition S1: Enterprise Information Structure. The organisational environment is conducive to IRM if there is an enterprise information structure consisting of at least a chief information officer (CIO), a data administration function, and a database administration function.**

The CIO is the senior management representative for information just as the CFO would be for finances. The CIO provides high level support for the IRM model, and promotes the view of information as a resource at the upper levels of the organisation, providing an injection of information management knowledge in the boardroom. The

second important function is that of data administration. This provides a single "bellybutton" for data management issues, as well as a point of control for managing the policy issues of data access and usage. Finally, the database administration function performs the physical implementation of organisational data policies in the enterprise.

Proposition S2: Strategic Information Planning. IRM is part of the organisational culture if there is a current Information Strategic Plan, integrated into the overall business plan and reviewed as part of the annual planning process.

The presence of a information strategic plan indicates that the management in the organisation believes that information is an asset that can and should be planned for in the yearly process for the organisation. The strategic planning process includes planning for the management and upgrade of information systems and technology to ensure that the information provided to the decision maker is the best information. The CIO is the champion for information at this level of the organisation.

Proposition S3: In an organisation that practices IRM principles, there is an enterprise wide data model, and that model is controlled by the Data Administrator. All applications are constructed based on the data element definitions held in the data model.

The enterprise wide data model is essential to enable the use of information as a corporate resource. Any organisation that fails to create and manage a data model for the organisation, is failing to manage its information effectively.

Proposition S4: In an organisation that practices IRM principles, a physical and electronic security plan will been have formulated and implemented, and will include a well defined and practised disaster recovery plan.

The security of the traditional resources is a vital issue for most organisations, and security of information is no less important. Organisations that sincerely care about

information as a resource must implement strategies that maximise the safety and security of that resource. To that end, implementation of data backup schemes, physical and emissions security, and a detailed, practice disaster recovery plan are essential elements for all organisations to consider.

Operational Propositions. Operational propositions are related to the operational aspects of information resource management. These propositions take the structural issues and look to see if there is follow through in application of the structural aspects, determining the level to which the IRM principles are operationalised in the organisation.

Proposition O1: In the organisation that practices the principles of IRM, information is readily sharable and available for use as needed to achieve organisational goals in and across functional boundaries.

The sharing of information is an operational issue, and requires that we consider the issues of inconsistency, redundancy, and data independence. The redundancy and inconsistency issues speak mostly to the replication in multiple isolated sources of information that is constant, for example name and social security number. The presence of redundancy and inconsistency reduces the overall quality of the information that can be extracted from the data sources.

Proposition O2: In an organisation that practices the principles of IRM, information is stored in accordance with an enterprise-wide data model.

The structural propositions based on the principles of IRM detailed in Table 4, require that an enterprise wide view of information be adopted, with the underlying basis being an enterprise wide data model. This operational proposition requires that the information be stored in accordance with the enterprise model. The intent is to ensure that

the organisational practices align with their policies in terms of information resource management.

Proposition O3: In orgnisations that says they value the principles of IRM but exhibit cpntradictory behaviours, we may find evidence of sub-unit ownership of information that can explain this discrepancy.

The organisational sub-units exhibit behaviours that are in line with ownership of the information. Non-standard, uncontrolled sources are created and utilised in preference to the information systems provided by the organisation. These secondary sources will often replicate content from other sources, and may even have been created from information extracted from these primary sources. The hallmarks of these systems will be inconsistency, redundancy, and inability to be shared. These systems will also not be managed in a systematic fashion, with links to the original source material neglected, and updates from the original source infrequent or overlooked.

Data Collection

The data for this research was originally collected during a study undertaken in the winter of 1996, and written up as AFIT-LA-TR-96-1 (Heminger et al., 1996). The initial study was intended to determine if there was a consistent underlying data model that could be used in the design of an Executive Information Systems (EIS) for AFIT, and that issue is reviewed as part of this study. The interview questions used during the interviews are provided at Appendix A, and follow a semi-structured format. The question types used are both directed and open-ended, with the intent of allowing the interviewer the opportunity to focus questions on specific areas that arise during the interview. This approach is considered valid because of the exploratory nature of the research.

The interviews were performed by members of the study team working in teams of two, and interviewing personnel in the AFIT directorates detailed in Figure 4. The interviewers prepared reports based on notes from the interviews, and returned these draft reports to the interviewee for confirmation of content. This follow-up process was used to reduce the opportunity for errors of transcription or memory that might create errors of analysis. These interview reports, along with the ancillary material collected during the interviews, constitute the data for this research.

Interview Subjects

The interview subjects were chosen from all directorates of the organisation, with an initial point of contact (POC) being appointed in each of the schools and directorates. These POCs were responsible for assisting team members in determining which elements of the organisation would be most appropriate to interview, given the operational nature of the information being collected. During the initial group of interviews, additional staff members were suggested as potential sources of information, with follow-up interviews scheduled for these other staff. This approach was intended to provide the broadest view of the information environment for the organisation.

Data Analysis

The data analysis will be accomplished by reviewing the reports from the interviews in light of the propositions presented earlier in this chapter. The collected data will be reviewed in terms of both the structural and operational propositions.

Summary

This chapter has identified that the case study research methodology will be applied in this study. The case study is appropriate as we wish to compare a set of principles proposed by the theoretical research with data collected in a real organisation, with the intent of determining how well theory matches practice. The data was collected as part of an earlier study using the personal interview, a choice made to provide flexibility to pursue specific issues that surface during the interview. The data collected during these interviews will be analysed to determine the organisations compliance with structural and operational propositions developed earlier in this chapter.

IV. Results and Analysis

Overview

The interview reports compiled during the initial study provide data on the information environment at AFIT. This chapter will extract from those reports the details on the current information systems utilised at AFIT in terms of internally and externally managed systems. Details on the AFIT information structure will also be extracted. This information will then be examined in light of the structural and operational propositions developed in Chapter III.

Subject of Case Study

Chapter II illustrated the lack of treatment of the issue of information ownership, and highlighted the need for this study. The organisation that will be used for this case study is the Air Force Institute of Technology (AFIT), Wright-Patterson Air Force Base (WPAFB), Dayton, Ohio. This organisation was chosen because the author had access to the organisation and its information practices.

Mission of AFIT. The stated mission of AFIT is to "support the Air Force through graduate and professional education, research and consultation (AFIT/RRD, 1993:1)."

Brief History. The Air Force Institute of Technology has been providing education in various forms to members of the United States armed forces, United States

Department of Defense and members of foreign allied military services for over 70 years (AFIT/RRD, 1993:1). The current primary roles for the Institute are those of educating for and granting graduate degrees at both the Masters and Doctoral levels, and providing professional continuing education for military and Department of Defense personnel. Other important roles include the provision of research and consulting services to the wider US defence community. The number of students who complete courses at AFIT each year is in the order of 30,000 of which the predominant number complete professional continuing education courses and some 350 complete graduate degrees.

Organisational Structure. The organisational structure that enables AFIT to perform the mission is presented in Figure 4. There are essentially three different components to the organisation: executive section, support section and schools. The executive section is composed of the Commandant and Vice-Commandant and their staff; the Quality Office; and the Academic Affairs Department. The director of Academic Affairs (CF) is equivalent to the university president at a civilian university. The support component includes the Library; Mission Support; Resources; Public Affairs; Admissions and Registrar; Communications and Computer Systems; and Plans and Operations. Finally, the schools component includes the Graduate Schools of Engineering and Logistics and Acquisition Management; the School of Systems and Logistics (Professional Continuing Education); the School of Civil Engineering and Services; and the Civilian Institutions Program.

In terms of organisational hierarchy, the support section commanders and the school deans are effectively at the same level. The executive organisation is one level above. The Commandant is the senior manager, and is subordinate to commanders at higher headquarters. The chain of responsibility places AFIT under the direction of Air University, which is in turn responsible to Air Education and Training Command.

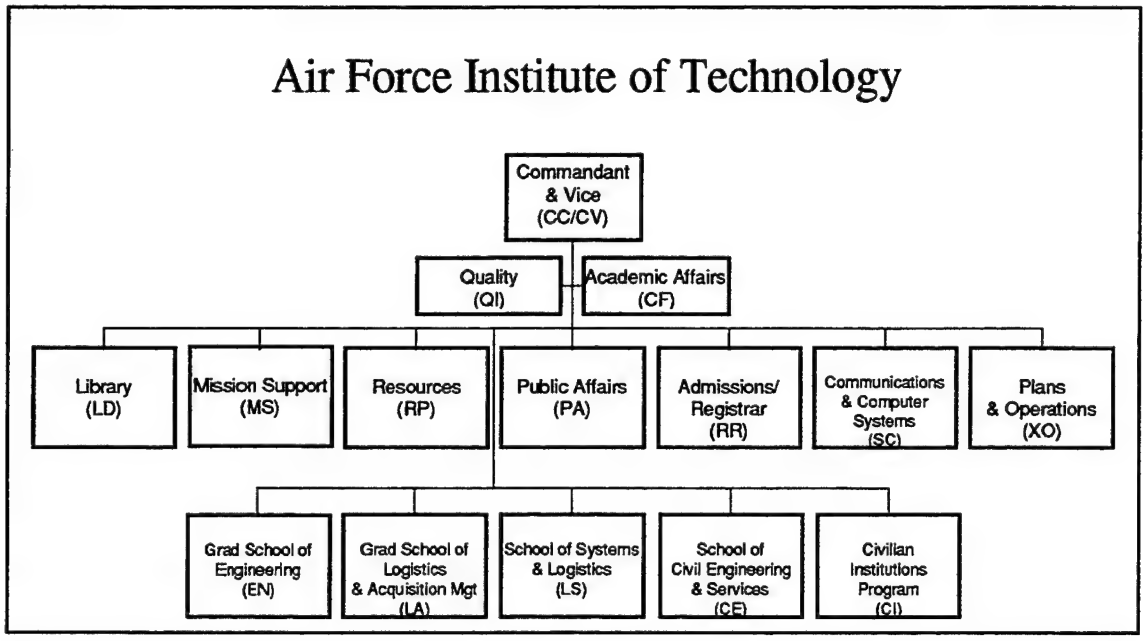

Figure 4: AFIT Organisational Structure

Internally, the AFIT structure is divided along functional lines, with each component of the support organisation responsible for a specific area of expertise: for example SC for computing and communications or RP for resource allocation and control. In a similar vein, the schools are broken down by speciality: engineering, logistics and acquisition, civil engineering, professional continuing education, and education at civilian institutions.

Results

The interviewers were able to collect a large amount of detail on the current structure of AFIT's information systems and information management practices during the interviews. This information was used to construct a view of AFIT's current information systems, and more specifically, internally supported and externally mandated data systems. The systems identified represent both manual and automated information systems. Further analysis of the information revealed details about the management practices applied to information at AFIT.

Information Systems

The tremendous strides in information technology have resulted in an information explosion, which affects almost all organisations of any size and complexity. In this, AFIT is no exception. The data collected during the interviews identified a large number of manual, semi-automated and automated information systems that are used to varying degree throughout AFIT for daily operations. These systems and the organisations that use them are listed in Table 6.

There are two systems composed of multiple sub-applications, and for these systems in Table 6 the primary system name is listed above the individual components. The first of these systems is the AFIT Student Information System (AFITSIS). AFITSIS is composed of four sub-applications: the Student Records System (STARS), the Quota Education and Education Transactions system (QUEST or Quota), Mission Support

Information/Orderly Room Functions (MSI/MSQ) and International Student Affairs (ISA).

Table 6: Application to Office Cross Reference Matrix
(adapted from Heminger et al., 1996:6)

Office / Application	CC	XO	LA	EN	PA	CI	MS	RP	LS	LD	RRD	RRA	CE	SC	QI	CF	RR
AFITSIS																	
STARS			X	X							X						X
QUEST												X					
MSQ/ MSI							X										
ISA		X															X
ACES																	
FEDS						X		X									
MIFFS						X											
APS	X		X	X		X			X	X				X			X
ASAS									X				X				
EES																	X
ENDB				X													
IPMS														X			
PROTRAC														X			
ACQMAN										X							
OCQMAN										X							
FORM9DB														X			
CSRDDB														X			
PC-III							X					X					X
ATLAS												X					
AFTMS									X								
UMD								X									
DFAS								X									
LS-STUD-INFO									X								

The second system is AFIT Civilian Education System (ACES), composed of the Management Information Financial Forecasting System (MIFFS) and the Financial Expense Data System (FEDS). The remaining systems are self-contained, independent applications, and are outlined in Appendix B.

The organisation of the systems and their relationships are best expressed in

Table 7: Management Responsibility for Information Systems Used by AFIT

	Management Responsibility	
Application	**Internal**	**External**
ACES	•	
ACQMAN		•
AFITSIS	•	
AFTMS		•
APS	•	
ASAS	•	
ATLAS		•
CSRDDB	•	
DFAS		•
EES	•	
ENDB	•	
FORM9DB	•	
IPMS		•
LS-STUD-INFO	•	
OCQMAN		•
PC-III		•
PROTRAC	•	
UMD		•

graphical form. To do this and retain some level of manageability, we decided to treat the applications as two categories: internally managed and externally mandated (Heminger et al, 1996:5). The list of systems in Table 6 is presented in Table 7 with management authority indicated either as internal or external.

The graphical representations of the relationships of the various information systems also presents a view of the underlying architecture of the information systems,

specifically in terms of the application, the database management system (DBMS) and the underlying file structure of the information system. The intent of this view is to provide detail of the data structure underpinning AFIT's information systems, both internal and external. These underpinnings are the framework on which the organisational data model is built, and knowledge of their structure and relationship is essential to managing the information resource in an effective manner.

Internally Managed Systems. The internally supported and managed information systems are represented in Figure 5. The primary goal of this map is to identify systems and their users, not necessarily to provide detailed information on what is stored in them. The systems supported by AFIT are constructed on varying technologies, from the relational models of Oracle, Dbase5 and Paradox to the flat file models of Microsoft Word and Excel. This is significant because information that is stored in a relational database management system can be stored physically once, then accessed and shared by many applications, each with its own view. With the four largest systems accessing a single relational database management system (Figure 6), it should provide the setting for a common pool of carefully managed data.

The level of control and management varies with the application and level of end user involvement. The primary applications hosted on the Oracle RDBMS are centrally managed and controlled by the Computer and Communications Systems Directorate (SC). Individuals are responsible for maintaining and controlling the databases hosted by them on their office PCs. The Dbase 5 and Paradox databases are not centrally hosted, and are the responsibility of the user community.

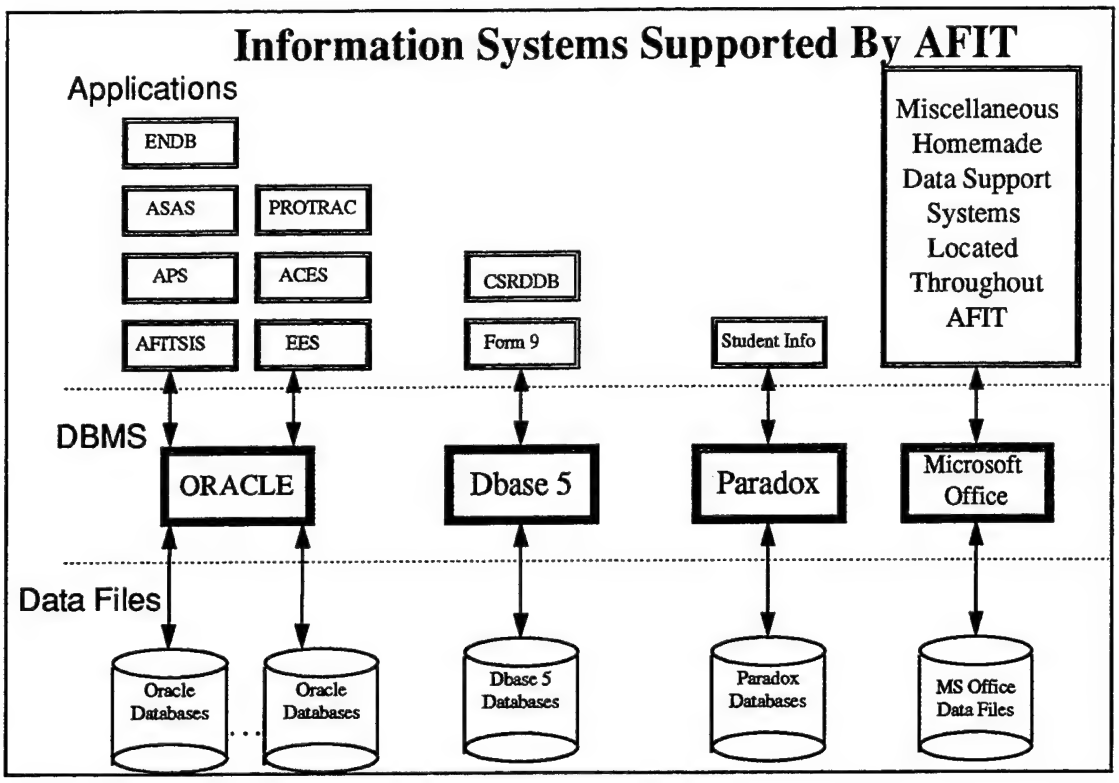

Figure 5: AFIT Supported Information Systems
(Heminger et al., 1996:7)

The Microsoft Office files located on office PCs are generally flat files created in word processing and spreadsheet applications. These files are distributed among the PCs of the users who created them. Further, the nature of the files renders them perishable, with little or no updating – in general they are single use objects. There are some files that are the repository of dynamic information, that are updated manually. These files are principally maintained by their users as the files have no equivalent in the centrally provided information systems. However, the files do contribute to the fragmentation of the data model for the organisation.

To compound the problem, investigation into the structure of the Oracle data bases indicated that there is no single consistent pool of data utilised by the applications

(Heminger et al, 1996:7). Instead it appears that as new applications were added or old ones modified the required tables were copied from one location to the new location and

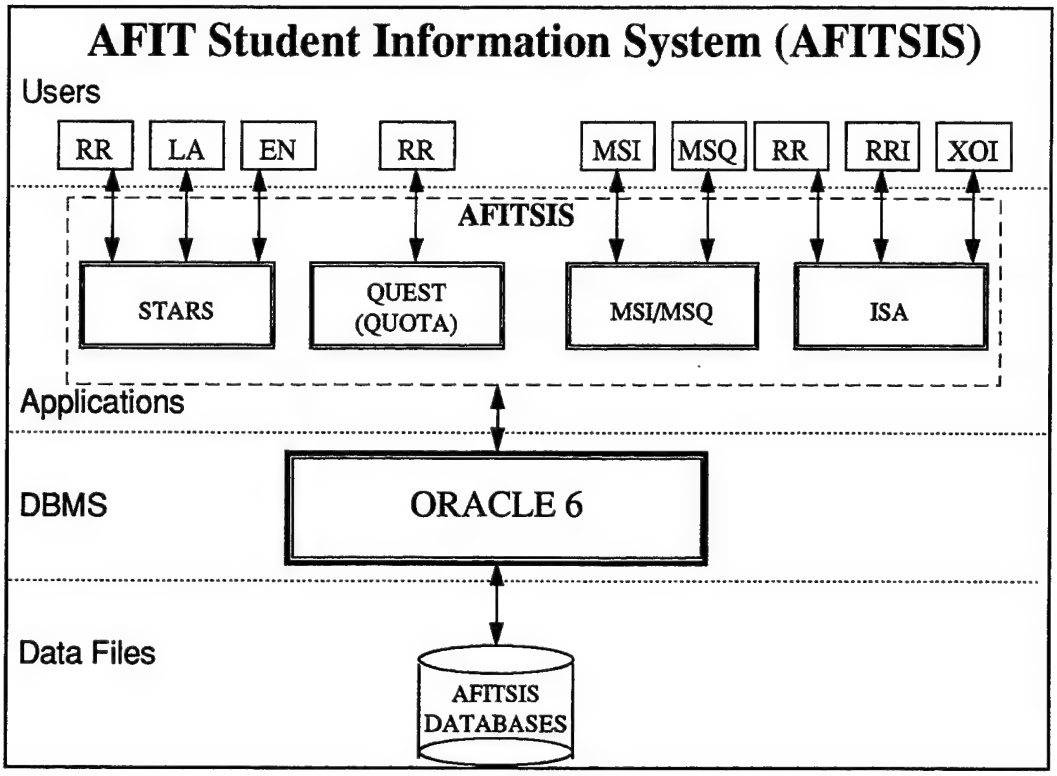

Figure 6: View of AFITSIS
(Heminger et al., 1996:8)

added to the database structure for the application. This has resulted in a level of data redundancy with data being stored in multiple locations, named differently, and often with different data attributes (Heminger et al, 1996:7). There is apparently no centrally managed data dictionary for all applications that developers can access to ensure they do not create duplication or inconsistency issues. This demonstrates the lack of a common data model.

The concern of new applications being generated ad hoc is complicated by the power of PC-based RDBMSs. The availability of these tools have enabled the creation of several small local-use systems, with little or no database administration support. Systems like these are often initially populated with data from information systems such as AFITSIS and ACES. The databases are then maintained in a manual fashion, with users entering updated information to keep the database current. A prime example of this type of system is the registrar style database within LS used for tracking student information. This competes directly with the systems used by the Registrar (Heminger et al, 1996:9).

The internally supported AFIT information systems suffer from a malady that afflicts many of the earlier generation of RDBMS implementations and applications in general: poor documentation and what users consider to be "a user-surly interface (Heminger et al, 1996:9)". More than one office indicated they could not rely on information being supplied by AFITSIS (STARS), because they themselves were not entering updated information (Heminger et al, 1996:9).

Externally Mandated Data Systems. The externally managed and mandated information systems that complete the AFIT picture are depicted in Figure 7. These information systems are generally Air Force wide in their implementation, and are something about which AFIT has little say, and just as little control. These systems have been developed by other agencies with their information needs in mind, and only a secondary interest in AFIT's needs as a user of these systems.

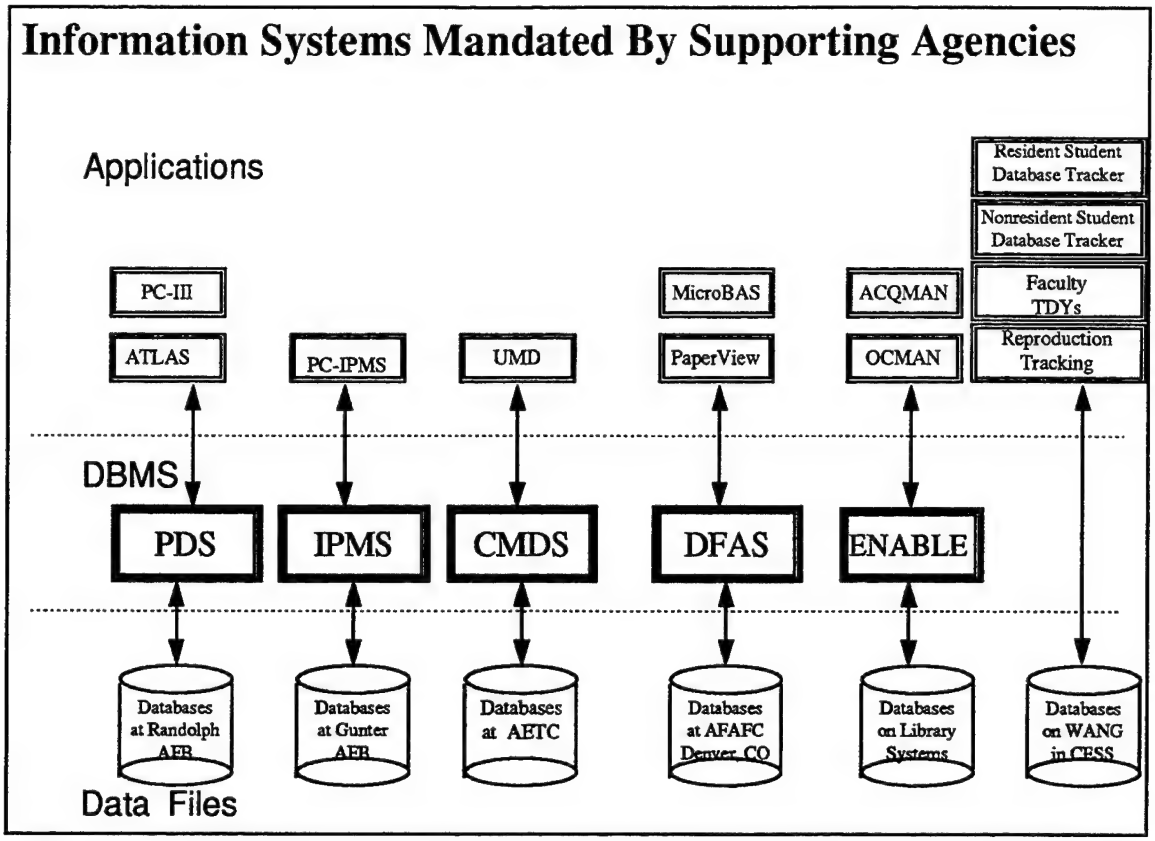

Figure 7: Information Systems Mandated by Supporting Agencies (Heminger et al., 1996:10)

Further, as these systems are developed externally, AFIT has to accept the data structure and definitions provided by the creators of these systems. Prime examples of these systems are PC-III and DFAS. These are mainframe based systems and use network connections to allow updates of the information to the host DBMS.

In addition to the mainframe based systems, there are some PC-based systems that are mandated for standardisation of data and management techniques within the Air Force. The ACQMAN and OCQMAN, which are Enable applications used for library financial management are examples of such applications.

Manual Systems. In addition to the computerised systems, many AFIT offices utilise manual or semi-automated processes. These systems have generally come into being as a response to a general distrust of the reliability and accuracy of the information maintained in the primary electronic information sources (Heminger et al, 1996:10). These manual systems consist of paper records and electronic files on PCs usually in a word processor, spreadsheet or PC database format. These systems are typically the systems used to prepare information for presentations, problem solving or in response to queries (Heminger et al, 1996:10).

Information Management

AFIT, like most organisations in the current era, has a formal strategic planning process in place. This strategic plan sets the organisational mission, vision and goals, and is supported by plans in each of the directorates. This set of hierarchical plans allows each sub-unit to determine where they fit into the overall picture for the unit. From an information systems point of view, however, there was no evidence of an information strategic plan, and no formal statement of how information would fit into the resource planning structure. The lack of a plan for information resource management was evident at all levels, even though there was a plan for management of the information systems and technology.

With the apparent lack of an information strategic plan discussed, it is appropriate to consider the management structure of AFIT, and the potential reasons for this lack. As mentioned earlier, we expect to see positions such as chief information or chief data

officer, data administrator, and database administrator if AFIT is implementing management techniques in concert with the principles of IRM. We note that AFIT is a hierarchical organisation, and as such has a well defined chain of command and executive power. The senior manager in the organisation is the Commandant, with the Vice-Commandant as second in command. Allowing for the differences in title in an Air Force organisation and those in a commercial organisation, there is no indication of the presence of a chief information or data officer in the executive. The closest link to information resource management in the organisation is identified in the SC component, the area responsible for maintaining AFIT's information systems and interfaces with external information systems. There is also no indication of the presence of a data administrator, the position responsible for the development and enforcement of information management policies for the organisation. The data administrator plays a very important role in managing the organisational data model.

There are identified database administrators, responsible for the implementation of changes to the various information system's database structure. These database administrators fulfil the role of security managers for the databases that they manage, monitoring the users allowed to access the various databases.

These database administrators are operating with the interest of their applications and direct users in mind – after all there is no strategic information plan to follow. Further, co-operation has been hampered by the compartmentalised nature of the information systems created to this point. Each has been developed with a particular use

in a given set of processes in mind, and the impact of enterprise wide needs and goals are suborned to the needs of the application.

Analysis

This section will compare the structural and operational propositions with the evidence collected during the interviews. This step will determine whether or not the implementation of IRM principles has been successful in this organisation.

Structural Propositions

> **Proposition S1: Enterprise Information Structure. The organisational environment is conducive to IRM if there is an enterprise information structure consisting of at least a chief information officer (CIO), a data administration function, and a database administration function.**

The data collected through interviews and analysis of the organisational chart for AFIT indicates that there is no chief information officer (or equivalent) that acts for information, specifically, at the executive level of the organisation. This lack of senior management support for the information resource makes an organisational view of information as a resource very difficult and will undermine the objectives of management. There is also no indication of the presence of a data administration function, responsible for the creation and implementation of data policies. This will hamper the creation of an organisational model of information that could be used for applications development to improve the quality of information available and hence the quality of decisions made by management in the organisation. From the information gathered, it appears that AFIT does not meet the requirements of Proposition S1.

Proposition S2: Strategic Information Planning. IRM is part of the organisational culture if there is a current Information Strategic Plan, integrated into the overall business plan and reviewed as part of the annual planning process.

The evidence indicates that AFIT has a strategic planning process in place, and that this planning process is indeed cyclical, with regular reviews and updates made to the plan. However, the AFIT Strategic Plan does not currently have an information counterpart, that would outline the information resource management goals and business information needs and opportunities. This limitation hinders the creation of focused information management strategies, and fails to make best use of the information resource. Information systems and information technology implementation is not co-ordinated to achieve best effect in service for the user of the systems.

Proposition S3: In an organisation that practices IRM principles, there is an enterprise wide data model, and that model is controlled by the Data Administrator. All applications are constructed based on the data element definitions held in the data model.

The effects of the lack of a strategic view of information in the organisation, and the accompanying lack of a formal information management structure are exacerbated by the lack of an enterprise wide view of data. One of the best features of relational DBMSs is the ability to easily share information between applications built on top of a common data model, using elements defined in a common data dictionary. Although AFIT has implemented several major systems in relational database systems, each system has been treated as a world unto itself with little regard given to later modification or maintenance. There is no enterprise-wide data model that identifies the entities about which information is collected, nor a data dictionary that defines the appearance of elements in those entities.

Consequently, what could be a pool of consistent, non-redundant data eminently suitable for sharing is not. It is in fact a collection of independent applications and data structures containing redundant, inconsistent information that regularly produces answers to similar queries that confound each other.

Proposition S4: In an organisation that practices IRM principles, a physical and electronic security plan will been have formulated and implemented, and will include a well defined and practised disaster recovery plan.

The area in which AFIT excels is the area of security: physical and electronic. The various AFIT information systems are subject to disaster recovery planning, and are also subject to strict access policies enforced by the network administration organisation in SC. The physical security of hardware, software and data is achieved through building access restrictions, and multilevel network security implemented through the installed operating systems. External access to the information in AFIT's information systems is also limited through the use of *air gaps* and other physical measures.

The disaster recovery plan for AFIT includes the regular backup of information stored on mass storage media, such as system hard disk drives.

Operational Propositions

Proposition O1: In the organisation that practices the principles of IRM, information is readily sharable and available for use as needed to achieve organisational goals in and across functional boundaries.

The most common theme throughout the interviews and investigation was the inability to obtain information necessary to perform tasks. There were numerous instances of asking the same question of more than one sub-unit and getting as many different

responses as units asked. This is generally the result of the presence of redundant and inconsistent information, a side effect of an incomplete data model for the organisation.

Another cause of the redundancy was the lack of knowledge of what data elements were held in databases in the organisation. This contributed to the creation of redundant data stores because applications were designed to collect all the information they needed to operate, with little knowledge of the information in other, similarly hosted, applications.

Proposition O2: In an organisation that practices the principles of IRM, information is stored in accordance with an enterprise-wide data model.

Given that we have shown that AFIT does not have a complete enterprise wide data model, the information that is collected is stored in multiple redundant database files, with inconsistency a recurring theme. In operational terms, AFIT is a good manager of information systems, on a per system level. However, AFIT does not have an overarching view of information in the form of an enterprise wide data model that can be used to solve problems as they arise in a fashion similar to that outlined in our ideal model of information resource management in Table 5. Rather it is a case of MIS management of information systems in the mode depicted in Table 3.

Proposition O3: In orgnisations that says they value the principles of IRM but exhibit cpntradictory behaviours, we may find evidence of sub-unit ownership of information that can explain this discrepancy.

Several components of AFIT identified alternate information systems they had created to provide information support for day to day business, usually replacing organisational information systems such as the STARS database. The organisational sub-units justified the creation and maintenance of these secondary sources by pointing to a

lack of trust in the accuracy of the data in the organisational system, a matter in which they were complicit, admitting they did not update the system either. The information maintained in these locally produced systems was generally not back-filled into the primary information systems to bring them up to date, an omission that also points to owning information, not stewarding it.

Summary

The data collected and analysed during this research have pointed to problems with information resource management in the AFIT organisation. There is no corporate information structure with the goal of managing the resource, there is no enterprise wide data model, there is no information management strategic plan, and data is certainly not readily available and sharable organisation wide. The users in some components of the organisation provided evidence of their perception of ownership of information by creating stand alone systems in response to difficulties with the primary systems. The ownership is confirmed with the omission of feedback to the primary system on the condition of information in the databases. In all aspects, AFIT's information management approach represents a typical MIS department in many, if not all, current organisations. The following chapter will discuss these findings.

V. Discussion

Overview

As the literature review in Chapter II made clear, information is a resource, and a valuable one at that. Drucker's assertion that information (as knowledge) is the primary resource (1992:95) may not find favour with all parties, but does point to the increasing impact that information is having on organisations. The emergence of a separate management field and a set of principles focused specifically on information are testimony to the concern that management and information systems professionals show for information. Notwithstanding these statements, we find that organisations still fail to manage information in a manner appropriate to a valuable resource, despite proclamations of support for the IRM philosophy.

The initial phase of this research provided a set of information-focused principles for information resource management, that moved the focus away from information systems and information technology and towards information itself. The second phase put forth a series of propositions designed to determine the level of implementation of these principles in organisations, and identified a subject organisation for a case study: AFIT. The results from that case study indicated that AFIT had not fully implemented the principles of IRM, but had been successful with some components: physical security, the presence of a database administrator, and had implemented the strategic planning process

for the business though not for the information. The overall information structure for the organisation was incomplete and there was no enterprise wide data model to speak of.

This chapter will build on the previous chapter by interpreting the data analysis and making some inferences about the possible causes for the failure to treat information as a resource at AFIT. These inferences will be extended to the general realm of information resource management where possible.

Ownership

The concept of information as a resource requires that we understand the impact of information ownership on information management in organisations. The objective of the case study was to find evidence to support or confound the notion of ownership at sub-unit level impacting the implementation of information management at AFIT. To understand the results, it is appropriate to consider the ownership of information at two levels: corporate and individual.

Corporate Ownership of the Information Resource. Corporate ownership of information implies the management of a resource utilising a well defined chain of command, with support at senior executive level, in much the same way as we would expect to manage finances or human resources. The literature proposes an information structure that equates to this financial structure and, as outlined in Chapter II, consists of a Chief Information Officer (CIO), a Data Administrator (DA), and a Database Administrator (DBA). The CIO is held responsible for the overall corporate management of the information resource, the DA is responsible for developing policy for use and

control of the information, and the DBA implements the policy for the organisational applications.

The results of the data analysis showed that AFIT did not possess an information management structure that would be conducive to ownership of the information at a corporate level. The information management profile would be well described by the MIS model of information management (Table 3), with most systems separately controlled, with the *whole* suffering from segmentation, compartmentalisation and exhibiting the maladies of redundancy and inconsistency that generally accompany this approach. The absence of a senior management representative with information responsibilities and the concomitant systems weaknesses, only reinforces the need for executive commitment to major projects of any type.

Let us for a moment take a more conservative approach and assume that the director of the SC directorate is the de facto CIO, with DBA's working for him maintaining the databases and providing oversight for the information in the organisation. Would AFIT then have corporate ownership of the information? If we look to the involvement in strategic planning, we see that AFIT plans for the business and for information systems per se, but does not show evidence of planning for the information resource. This provides a further indication that AFIT does not corporately own the information in its information systems. After all, this planning omission for the overall resource would not be compromised for finances in the organisation.

This lack of planning is compounded by the lack of knowledge of what information is actually contained in the systems used by AFIT. For all the information systems that

have been created and implemented at AFIT, very few staff have full knowledge of the contents of the organisational databases, making it difficult for the organisation to describe and make concrete the scope of the resource that needs to be managed. This situation would not be allowed to happen with finances: organisations go to extraordinary lengths to ensure that they know where every dollar and cent is to satisfy internal financial management regulations. Information, as a resource, must be accorded similar status, and organisations must develop ownership of their information.

Individual Ownership. If AFIT does not exhibit corporate ownership of the information, then at what level is information owned in the organisation? During the analysis of the data, we determined that some of the sub-units of the organisation displayed ownership of their information, at this lower organisational level. The ownership behaviours exhibited included creation of separate systems to manage information particular to their task, often created from information originally obtained from the primary information systems. These systems were treated proprietarily, with their existence, while not concealed, definitely not advertised to the existing information management structure. This attitude of ownership of information, as determined from the behaviours exhibited, contributes to the propagation of unmanaged, uncontrolled information sources that readily confound the organisations view of its information base.

In fact, the effect can be more profound, if the systems that are created at these lower organisational levels collect information that is already collected by the organisation and supplement this with information that the organisation is unaware it collects. If for example the sub-unit needs to consolidate information about staff or students to an extent

that it might breach the Privacy Act, then the organisation may be set up for legal problems, without being aware that it was a possibility. If there was a wider organisational view of the information then this would not occur.

Alternatively, the individual components may be collecting information that is valuable to the success of the organisation, but because they behave as owners of this information, its collection may be masked from the organisation, causing duplication of effort, or impacting on the ability of the organisation to satisfy higher organisation questions. Here the quality of decision made by the organisation or relating to the organisation may well be reduced because of the reduced information quality.

Stewardship of Information in the Sub-Unit

Recognising now that ownership of information at the lower levels of the organisation is problematical, we propose stewardship as an alternative. As discussed in Chapter II, stewardship is the management of something on behalf of the owner, with the knowledge that at some point the owner may require a reckoning or accounting of the use and management of that something. Again, stewardship is not a new concept to us, and is a recognised methodology for management of resources: land is often managed by a landlord or property manager; capital by representatives of the chief financial officer (CFO); and labour by personnel agencies. It is fair to argue that stewardship at the user level is an appropriate means for managing a resource.

Recognising once again that information is a resource, we assert that the management of this resource at the user level should be through stewardship. This

requires that the resource be owned at the corporate level, however, and could be expected to degrade to information ownership at low levels if this support is not provided.

If the organisation takes ownership of the information in its systems then they will move to implement a management structure for the information resource as outlined in Chapter II. This executive level support will provide the backing for the information management organisation to implement strategic planning in line with the business planning cycle, providing more opportunity to manage the land, labour and capital components required to make information work for the organisation. Part of the strategic vision for information management in the organisation will be the access to the right information, at the right time for the right people, and this will require the creation of the organisational data model. As part of ensuring the right people, and only the right people have access to the information, the information organisation will develop and deploy a security plan covering physical and electronic security of the resource.

If this process has familiar undertones, it is because it is a process that is embodied in the management of the other recognised resources. It should be noted that the conversion of information to a resource in the eyes of individuals in the organisation requires training and a cultural shift similar to that required by the Total Quality Management movement. Individuals must learn that their actions affect the operation of the organisation, and that information can be made more usable and valuable by creating an open environment, where everyone gets the information they need to do their jobs.

The original stewards were used to take on the role of leader in feudal kingdoms when the monarch went to battle, and as such they were held high in the minds of the

people. The individuals in an organisation are being given the role of steward of the information because we want them to take responsibility for the quality and use of information the organisation has.

The benefits of stewardship for the organisation and the individual when stewardship is applied should be reiterated at this point. If we implement stewardship at the lowest levels, and put in place the organisational structure to support this philosophy, then the decisions made in the organisation will be based on the highest quality information. We can expect that these decisions will lead to better utilisation of the other organisational resources: Land, Labour, and Capital. From the user perspective, they will have better access to more information in the organisation and will be able to rely on its accuracy. Finally, the information store will be more flexible; a knowledge of the enterprise data model will make creating new queries and answering new questions simpler and faster.

Recommendations

The information collected during the case study highlights an issue that affects many organisations. The most important issue is that of information ownership. Without addressing the issue of ownership in the organisation, and gaining or regaining control of the information, the organisation has little chance of managing the information to an acceptable level, and as will be necessary for future needs. Corporate ownership will pave the way for the creation of a corporate culture where information is viewed as a resource to be used to best effect by organisation members.

To achieve the necessary support for the information as a corporate resource, organisations need to look at creating a corporate information structure, responsible for the creation and implementation of policy, and management of physical information systems issues. The appointment of a Chief Information Officer (CIO) at a level similar to the senior financial advisor, is a first important step. The CIO is the champion for the use of the information resource in the organisation, and has significant input to make in the planning process. The CIO is supported by the presence of the Data Administrator and the Database Administrator.

As the information support structure is put in place, and the organisation develops the resource view of information, the users are going to recognise the value of knowing what information is being held by different parts of the organisation. Also, these users are going to want to gain access to this information, without having to rely on the manual methods of the past, particularly if the information has already been collected. For these reasons, organisations need to look to integrating the databases they currently have, and thereby creating a comprehensive data model for the organisation. The model need not be complete to the lowest level, but must have the definitions for the data elements standardised, so that they are used consistently in applications.

With the creation of the data model for the organisation, the staff will begin to gain an appreciation for where there are true limitations in the information systems they have, and there will be better opportunities to plan and manage the already scarce resources. The creation of a strategic plan for the management of these information resources will add to the opportunities for resource management in the organisation. As the information

strategic plan is part of the overall planning cycle for the organisation, the impact of strategic business decisions on the information needs for the organisation will be picked up in a more timely fashion. The impact of information systems decisions will also be more visible at higher levels, allowing customers to be more aware of how their information needs affect the organisation.

The issues highlighted here are valid for information resource management at AFIT and many other organisations.

Limitations

This is a preliminary study and as such, is limited to the study of a single organisation. This prevents us from taking into account the effects of organisational culture and hierarchy. This is as true for a highly structured organisation as it is for an organisation in private industry. Both will suffer from behavioural differences that may affect the case study results, with the implementation and enforcement of policies in both types of organisations resulting in differing cultural atmospheres. Further, the mission perspective will influence the importance of information in the organisation in general.

Recommendations for Future Study

This research is preliminary, and has the limitations addressed above. For these reasons, there are several areas that this research exposes for further research. The first area is the confirmation of the case study results, through further case studies. The study of one organisation limits the generalisability of the results of the research. The

organisational structure and goals may affect the level of success with which the principles of IRM are implemented.

The next area that is of interest to study, is that of the effects of organisational culture on the ownership of information. Are there preferred organisational structures that maximise the level of control exerted on the information resource, and reinforce the stewardship role of users of information? This may affect the organisational structure we choose for future information centric organisations.

Conclusions

Without doubt, the Information Age has dawned, and information is being recognised as a resource that organisations can and should manage. This elevation of information has impacts for all organisations, and successful implementation of management approaches suited to the management of information will be critical to the success of organisations. Ownership of the information is rightly instituted at an organisational level, and not at sub-unit level. This places information in an arena where its ownership is vested with executive level staff, and affirms the recognition of information as a resource.

With the organisation providing ownership for the information, we grant stewardship of the information at a user level. Stewardship implies that users are allowed to use the information to achieve their tasks, but they will also be held responsible for the proper management and care of the information they steward. This encourages the user to be more circumspect in the gathering, storage and use of the information. This cultural

change will not be instantaneous, but will develop in the more open environment encouraged by stewardship.

The change in culture will be assisted by the implementation of enterprise data models, a more clear delineation of responsibility for information management, and the ability to plan better and utilise the limited information resources for best effect.

Appendix A: Data Collection Interview Questions

1. Tell me a little about your involvement in meeting the information needs of the Commandant. In other words, where do you fit into the process?
2. Do you generate periodic reports for the Command Section?
   - How often?
   - What types?
   - Can we have a copy?
3. Do you generate ad hoc reports for the Command Section?
   - How often?
   - What types?
   - Can we have a copy?
4. What sources do you have to go to (databases, other offices, etc.) to collect the information **you** require to meet information needs of the Commandant.
   - How often?
   - Once you get that information, what do you do with it?
5. Is there someone else who could give us further information on the reports you generate? In other words, who do you go to when you need help getting more information?
6. Do you answer requests for information from other agencies in response to a tasking THEY have received from the Command Section?
   - From whom?
   - How often?
7. What kind of problems, if any, do you run into when trying to get information to the Command Section? For instance problems with other agencies, format inconsistencies, unclear guidance.
8. Do you ever get taskings from outside agencies ABOVE Commandant's level that are not co-ordinated through the Commandant's office?
   - From whom?
   - How often?
   - How do they get handled?
9. When you get requests/taskings from the Command Section, how many days do you normally have to turn the response? Is that enough time? How could this be improved?
10. If this office has been identified as a source for another office's reports, provide a copy of a the report and ask where they got the information.
11. Is there anything else you would like to tell us?

- OBTAIN COPIES OF ANY REPORTS THEY HAVE ON HAND
- SEE IF THEY CAN SKETCH OUT ANY OF THEIR PROCESSES

Appendix B: Acronyms and Definitions

Access - Relational database management system (RDBMS) by Microsoft®. Software with the ability to create and manipulate databases.

ACES - AFIT's Civilian Education System. Includes MIFFS and FEDS.

ACQMAN - Financial software used by the library (LD). Its use is mandated by Central AF Services. Operates through the integrated software package known as Enable®.

ADAMS - Academic Data And Mass Storage.

ADPE - Automated Data Processing Equipment.

AFITSIS - AFIT's Student Information System. Includes STARS, QUEST (QUOTA), ISA, MSI, and MSQ.

AFPC - Air Force Personnel Center.

AFTMS - Air Force Training Management System

APS - AFIT Personnel Mgt System (formerly PMS)

ASAS - Automated Space Allocation System.

ATLAS - The Headquarters Air Force (HAF) information retrieval system. A structured query language (SQL) used to access data in PC-III.

ATRRS - Army Training Resource and Requirements System.

AUOP - Air University Operating Plan.

CMDS - CoMmand Database System.

COBOL - COmmon Business Oriented Language.

Data Administrator - An organisational function responsible for database planning and for establishing policies for accessing and maintaining databases.

Data Stores - Manual or automated inventories of data.

Database Administration - An organisational function responsible for the technical aspects of establishing and maintaining databases, in line with the policies laid down by the data administrator.

dBase 5 - A RDBMS by Borland®. Software with the ability to create and manipulate databases.

DBMS - Database Management System.

DIN - Data Identification Number. Used in PC-III applications.

EES - Equivalency Exam System

EIS - Executive Information System. Information systems which provide higher-level managers with direct and easy access to aggregated information and detailed data.

ENDB - AFIT/EN Database Applications.

Excel - Spreadsheet application from Microsoft®.

FEDS - Financial Expense Data System. Subsystem of ACES.

Fourth Generation Language - A very-high-level programming language that permits the programmer or user to specify what is wanted from the computer rather than how this should be obtained. Many of these languages are directly employed by end users.

IPMS - Information Processing Management System. Stores ADPE data for the Air Force. The IPMS database is located at Gunter AFB.

ISA - International Student Affairs. Subsystem of AFITSIS.

MIFFS - Mgt Information Financial Forecasting System. Subsystem of ACES.

MSI - Mission Support Information. Subsystem of AFITSIS.

MSQ - MSQ Orderly Functions. Subsystem of AFITSIS.

OCMAN - Financial software used by the library (LD). Its use is mandated by Central AF Services. Operates through the integrated software package known as Enable®.

Oracle - A commercial RDBMS incorporating the SQL data access language.

Paradox - A database application and development system available in DOS and Windows.

PC-III - Personnel Concept 3. The Air Force's Personnel Data System (PDS) which has the capability to store, update, and retrieve data on all Air Force personnel. The system has a direct link to AFPC. The PSM is in charge of maintaining the system. AFIT's PSM is located in RRA.

PC-IPMS - Personal Computer Information Processing Management System. SC uses PC-IPMS to update local IPMS database which contains ADPE data. Periodically, PC-IPMS is used to electronically update the Air Force's host IPMS database which is located at Gunter AFB.

PDS - Personnel Data System.

PowerPoint - Presentation graphics program by Microsoft®.

PROTRAC - Project Tracking system developed by SC.

PSM - Personnel Systems Manager. Individual in charge of maintaining PC-III. AFIT's PSM is located in RRA.

Query Language - A fourth-generation language for retrieving data from databases.

QUEST - QUota Education & Selection Transactions (also known as. QUOTA) . Subsystem of AFITSIS.

RDBMS - Relational Database Management System.

SQL - Structured Query Language.

STARS - STudent Records System. Subsystem of AFITSIS.

Synonyms - An alias for a table, view, sequence, or program.

Table - A basic unit of storage in an ORACLE database.

View - A custom-tailored presentation of the data in one or more tables.

Word - Word processing application by Microsoft®.

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Vita

FLTLT Trevor W.M. Plant was born on 13 November 1965 in Birmingham, England. In 1976 his family emigrated from their native Ireland to the suburb of Chester Hill in Sydney, Australia. He attended and graduated from Chester Hill High School in 1983 and entered undergraduate studies in Aeronautical Engineering at the University of New South Wales, in Sydney, Australia. He graduated with a Bachelor of Aeronautical Engineering in May, 1988. FLTLT Plant was commissioned into the Royal Australian Air Force on 01 February 1986.

His first assignment was to No. 3 Aircraft Depot at RAAF Base Amberley in SE Queensland, working with the engine for the F-111C aircraft. From Amberley, he moved to RAAF Headquarters Logistics Command (HQLC) in Melbourne, Victoria into the role of Systems Engineering specialist for the engine. While posted to HQLC FLTLT Plant earned a Graduate Diploma in Computer Engineering from the Royal Melbourne Institute of Technology. Other positions filled during the posting to HQLC included maintenance, project and contract management roles.

In May 1995, FLTLT Plant entered the Graduate Information Resource Management program in the School of Logistics and Acquisition Management, at the United States Air Force Institute of Technology.

Permanent Address: 35 Vales Road
Mannering Park NSW 2259
Australia

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13. ABSTRACT (*Maximum 200 Words*)

Information is an important resource for businesses and government, with information quality influencing decision quality, and highlighting our need to manage our information well: as a resource. Information Resource Management (IRM) has as its goal the management of information as a resource, but has not been implemented with the level of success expected. Problems with the implementation of IRM are indicated by the presence of redundant or inconsistent data, inability to share information across systems, and difficulty finding the information on systems. We propose that these difficulties are related to behaviours linked to perceived ownership of corporate information by organisational sub-units. To evaluate the proposition, we performed a case study on an organisation to see if we could identify the presence of problems, and the presence of the ownership behaviours. The case study revealed the presence of both problems with information management and behaviours related to ownership. To improve the management of information in organisations, we recommend that organisations take ownership of the information resource at the corporate executive level, and educate users of the information on the benefits of stewardship of the information they use. This will encourage staff at all levels to see information as a resource, not merely a cost of doing business.

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AFIT RESEARCH ASSESSMENT

The purpose of this questionnaire is to determine the potential for current and future applications of AFIT thesis research. **Please return completed questionnaire** to: AIR FORCE INSTITUTE OF TECHNOLOGY/LAC, 2950 P STREET, WRIGHT-PATTERSON AFB OH 45433-7765. Your response is **important.** Thank you.

1. Did this research contribute to a current research project? a. Yes b. No

2. Do you believe this research topic is significant enough that it would have been researched (or contracted) by your organization or another agency if AFIT had not researched it?
a. Yes b. No

3. **Please estimate** what this research would have cost in terms of manpower and dollars if it had been accomplished under contract or if it had been done in-house.

Man Years_____ $_____

4. Whether or not you were able to establish an equivalent value for this research (in Question 3), what is your estimate of its significance?

a. Highly Significant b. Significant c. Slightly Significant d. Of No Significance

5. Comments (Please feel free to use a separate sheet for more detailed answers and include it with this form):

_____ _____
Name and Grade Organization

_____ _____
Position or Title Address